L1: Entry 1 of 2 File: JPAB Jul 22, 1992

PUB-NO: JP404201610A
DOCUMENT-IDENTIFIER: JP 04201610 A
TITLE: PNEUMATIC TIRE WHICH REDUCES NOISE

PUBN-DATE: July 22, 1992

INVENTOR-INFORMATION:

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ASSIGNEE-INFORMATION:

NAME	COUNTRY
BRIDGESTONE CORP	

APPL-NO: JP02330605
APPL-DATE: November 30, 1990

INT-CL (IPC): B60C 11/12; B60C 11/03; B60C 11/11

ABSTRACT:

PURPOSE: To reduce pattern noise by forming longitudinal row block groups by peripheral groove and lateral groove, dividing them into a plural number of longitudinal row blocks per the predetermined pitch in the peripheral direction and forming a knotch in the peripheral direction in each block in such a way that the number of block groups having large pitch is larger than the number of block groups having small pitch.

CONSTITUTION: Longitudinal block groups 5 to 5 per two rows are formed on both sides of central peripheral line 0 by peripheral grooves 1a, 1b, a central peripheral groove 2, and lateral grooves 3a, 3b, 4a, 4b. Further, each longitudinal block group 5 to 6 is arranged, for example, at a combination of the length in peripheral direction of each block 5a to 5c, 6a to 6c which includes adjacent lateral grooves 3a, 3b on one side and a plural number of pitch length P1 to P3. And, in each block 5a to 5c, 6a to 6c, the number of block groups which are parallel with the lateral grooves 3a to 4b and have long pitch is large to form a knotch 9. That is, they are provided in such a way that pitch P1 is one, pitch P2 is two, and pitch P3 is three in the illustration.

L1: Entry 2 of 2 File: DWPI Jul 22, 1992

DERWENT-ACC-NO: 1992-295175
DERWENT-WEEK: 199236

TITLE: Pneumatic tyre with reduced pattern noise and localised wear - has block formed by grooves and having transverse sides for increased uniformity of shear stiffness

PATENT-ASSIGNEE:

ASSIGNEE	CODE
BRIDGESTONE CORP	BRID

PRIORITY-DATA: 1990JP-0330605 (November 30, 1990)

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PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 04201610 A	July 22, 1992		005	B60C011/12

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP 04201610A	November 30, 1990	1990JP-0330605	

INT-CL (IPC): B60C 11/03; B60C 11/11; B60C 11/12

ABSTRACTED-PUB-NO: JP 04201610A
BASIC-ABSTRACT:

Pneumatic tyre has circumferential grooves, and many transverse grooves, forming several files of blocks on the tread surface. The pitch length P, i.e. the circumferential length of each block, is varied and each file of blocks has a combination of different pitch lengths P1, P2 and P3. Each block has tranverse sipes dividing it in the circumferential direction and that the number of sipes on tbe block is increased with the increase of the pitch length P, for instance, the blocks with pitch length P1 and P2 have one sipe each, while the block with pitch length P3 has two sipes.

ADVANTAGE - Uniformity of shear stiffness of the blocks is increased, leading to an effective redn. of both pattern noise and localised wear.

CHOSEN-DRAWING: Dwg.0/4

TITLE-TERMS: PNEUMATIC TYRE REDUCE PATTERN NOISE LOCALISE WEAR BLOCK FORMING GROOVE

TRANSVERSE SIDE INCREASE INIFORM SHEAR STIFF

DERWENT-CLASS: A95 Q11

CPI-CODES: A12-T01B;

POLYMER-MULTIPUNCH-CODES-AND-KEY-SERIALS:
Key Serials: 0009 0231 2624 2628 2657 2826 3258

Multipunch Codes: 014 032 04- 41& 50& 551 560 562 566 597 598 651 672 699

SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1992-131216
Non-CPI Secondary Accession Numbers: N1992-226020

Previous Doc Next Doc Go to Doc#

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　平4-201610

⑤Int. Cl.⁵　識別記号　庁内整理番号　㊸公開　平成4年(1992)7月22日

B 60 C 11/12　C　7006-3D
11/03　A　7006-3D
11/11　D　7006-3D

審査請求　未請求　請求項の数 1　（全5頁）

㊹発明の名称　騒音を低減した空気入りタイヤ

㉑特　願　平2-330605
㉒出　願　平2(1990)11月30日

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明　細　書

1. 発明の名称　騒音を低減した空気入りタイヤ

2. 特許請求の範囲

1. 1対のサイドウォール間にまたがってトロイダル状に連なるトレッドに、このトレッド円周に沿って延びる複数の周溝及びこれら周溝を横切る向きで延びる多数の横溝にて区画される縦列ブロック群をそなえ、さらに該ブロック群の各ブロックにおいて対辺をなす横溝の一方を含むブロックの周方向長さで定義されるピッチ長さにつき、複数のピッチ長さを組合わせて縦列ブロック群を配列した空気入りタイヤであって、

上記ブロックは該ブロックを周方向に実質上分断する切込みを有し、各ブロックにおける切込みの本数は、短いピッチ長さに属するブロックよりも長いピッチ長さに属するブロックで多くしてなる騒音を低減した空気入りタイヤ。

3. 発明の詳細な説明

（産業上の利用分野）

この発明は、タイヤ騒音、中でもパターンノイズの低いトレッドパターンをそなえる空気入りタイヤに関する。

タイヤ騒音は様々な原因によって発生し、中でもトレッドパターンに起因した、いわゆるパターンノイズの占める比率は大きい。このパターンノイズは、トレッド接地面と路面との間で圧縮された空気がトレッドの溝を介してトレッド接地面の外側に急激に流出し、この現象が断続して起こるために生じるノイズで、ポンピングノイズとも呼ばれる。

（従来の技術）

このパターンノイズは、トレッドパターンにいわゆるピッチバリエーションを付与することで低減可能である。

すなわちタイヤトレッドの周溝及びこれを横切る横溝で区画されたブロックに該ブロックの対辺をなす一方の横溝を含めた構成単位をピッチとし、

周方向長さの異なる複数種(通常の乗用車用タイヤで3～5種)のピッチをランダム又は規則性をもたせて配列することによって、パターンノイズを低減するものである。

(発明が解決しようとする課題)

このピッチバリエーションを導入したブロックパターンでは周方向に並列した各ブロックはほぼ相似形をなしているため、周方向のせん断剛性は不均一になる。するとトレッド接地面内における周方向接線力はタイヤ転動時に変動する。この変動は、タイヤ転動時に、トレッド部を周方向に加振したことと同様の効果を生じ、接地面で発生する振動及び騒音を増大させてしまうため、ピッチバリエーションによる低騒音化を阻害することになる。

また各ブロックの剛性に差が生じるとタイヤ転動時の接地性が悪化し、運動性能の低下につながる上、トレッド円周上での剛性段差は偏摩耗の原因となり得る。

そこでこの発明は、パターンノイズの低いピッチバリエーションを導入したブロックパターンにおける各ブロック間でのせん断剛性を実質上均一化し得るトレッド構造について提案することを目的とする。

(課題を解決するための手段)

この発明は、1対のサイドウォール間にまたがってトロイダル状に連なるトレッドに、このトレッド円周に沿って延びる複数の周溝及びこれら周溝を横切る向きで延びる多数の横溝にて区画される縦列ブロック群をそなえ、さらに該ブロック群の各ブロックにおいて対辺をなす横溝の一方を含むブロックの周方向長さで定義されるピッチ長さにつき、複数のピッチ長さを組合わせて縦列ブロック群を配列した空気入りタイヤであって、

上記ブロックは該ブロックを周方向に実質上分断する切込みを有し、各ブロックにおける切込みの本数は、短いピッチ長さに属するブロックよりも長いピッチ長さに属するブロックで多くしてなる騒音を低減した空気入りタイヤである。

さて第1図にこの発明に従う空気入りタイヤのトレッド要部を示し、このトレッドを、トレッドの中央周線Oに沿って延び、それぞれ中央周線Oの両側で対をなす周溝1a, 1b 及び中央周線O上で延びる中央周溝2と、これら周溝を横切る向きに延びて各周溝間又は周溝1a, 1b 及びトレッド端T間をつなぐ横溝3a, 3b 及び4a, 4b とによって、中央周線Oの片側に2列両側で4列の縦列ブロック群5～8を区画してなる。

これら縦列ブロック群5～8は所定のピッチバリエーションに従って複数のピッチの組合わせで配列し、すなわち隣接する一方の横溝を含む各ブロックの周方向長さを複数種のピッチ長さに従って変化する。

トレッドの中央周線Oに対して対称をなす縦列ブロック群5及び6について説明すると、導入するピッチバリエーションは周方向長さの異なるピッチP_1～P_3の3種($P_1<P_2<P_3$)で、これらのピッチに対応して各縦列ブロック群を3種のブロック長のブロックから構成する。すなわち縦列ブロック群5及び6において、ピッチP_1に対応するのはそれぞれブロック5a及び6aで、同様にしてピッチP_2にブロック5b及び6bが、そしてピッチP_3にブロック5c及び6cがそれぞれ対応する。

さらに各ブロックは該ブロックを周方向にてほぼ均等に分断し、この実施例において横溝3a, 3b と平行に延びる切込み9をそなえる。この切込み9は上記の短いピッチ長さの区域に配したブロックよりも長いピッチ長さの区域に配したブロックでの設置数を多くする。

すなわち図示例においては、ピッチP_1及びP_2に対応するブロック5a, 5b及び6a, 6bで1本であるのに対し、ピッチP_3に対応するブロック5c及び6cで2本とし、少なくとも最小ピッチP_1と最大ピッチP_3に対応するブロックの切込み9の本数に差を設ける。

ここで各ブロックの切込み9によって分断された部分の周方向長さを分断ピッチと表し、ピッチP_1に対応するブロック5a及び6aでの分断ピッチをL_1及びピッチP_3に対応するブロック5c及び

6cでの分断ピッチをL_3とすると、上記切込み9の本数差によって、分断ピッチL_1とL_3とが近づくことになる。

なお切込み9は補助横溝10a及び10bを介して周溝1a, 1b及び中央周溝2へ開口し、さらにこれら補助横溝10a及び10b間とこれら補助横溝及び横溝3a, 3b間とを切込み9とは別の経路で補助切込み11によってつないでいる。

また図示例では、上記した縦列ブロック群5及び6の外側の縦列ブロック群7及び8においても、ピッチバリエーションを導入するとともに、各ピッチ長さに対応させて各ブロックの切込み9の本数を変化させているが、少なくとも縦列ブロック群5及び6において切込み9の本数を変化させることが有効である。

さらに縦列ブロック群7及び8において、横溝4a, 4bは周溝1a, 1b側で浅くかつトレッド端T側で深く形成し、また周溝1a, 1b側から延ばした切込み9はショルダー部側へ延びる補助横溝12とつなげてある。

なおこの発明に従うタイヤの他の構造は、従来タイヤの慣習に即ったものでよい。

すなわちカーカスは、ビードコアのまわりをタイヤの内側から外側へ巻返した少なくとも1枚（多くて3枚）のターンナッププライになり、プライはレーヨン、ナイロンおよびポリエステルで代表される繊維コードをタイヤの赤道面と実質的に直交する方向（ラジアル方向）に配列したものを用い、ベルト層は、スチールコード、芳香族ポリアミド繊維コードなどの非伸長性コードをタイヤの赤道面に対して10〜35°の角度で配列したベルトの少なくとも2層を互いに交差させて配置した主ベルト層の全幅にわたり、ナイロンコードで代表される熱収縮性コードをタイヤの赤道面と実質上平行に配した少なくとも1枚の補助ベルト層を、その形成に当っては主ベルト層の円周に沿ってコードを複数本並べたリボン状態によりらせん巻きしてなるものをそれぞれ用いる。そしてこのベルト層上に、上記したトレッドを配置する。

（作　用）

ピッチバリエーションを導入したブロックパターンにおいて、ピッチ長さに対応させてブロックの切込みの本数に差を設けることによって、各ブロック間での分断ピッチを均等化し、各ブロック間でのせん断剛性、ひいては周方向接線力を均一化することが可能になる。

すなわちブロックの接線力は周方向におけるブロックのせん断剛性に比例し、さらにこのせん断剛性はブロックの周方向長さのほぼ3乗に比例すると考えられる。

例えば第2図(a)及び(b)に示すように、最小ピッチP_1及び最大ピッチP_3に属するブロック5a及び5cをそれぞれ1本の切込み9にて周方向で均等に分断したときのせん断剛性比は、ブロック5a及び5cの周方向長さを便宜的にそれぞれP_1及びP_3と表すと、

$$\{2\times(P_3/2)^3\}/\{2\times(P_1/2)^3\}=(P_3/P_1)^3$$

となってピッチ長さに比例するため、せん断剛性はブロック5aよりもブロック5cで高くなる。

これに対して同図(c)に示すように、最大ピッチP_3に属するブロック5cを2本の切込み9にて周方向で均等に分断したときのブロック5aに対するせん断剛性比を同様に表すと、

$$\{3\times(P_3/2)^3\}/\{2\times(P_1/2)^3\}$$
$$=2/3(P_3/P_1)^3$$

となり、せん断剛性比は同図(b)に示した例に比較して2/3に減少するため、ブロック5a及び5cのせん断剛性は均一化に向かうことになる。

ここでブロックに設ける切込みの本数は、最小ピッチP_1に属するブロック及び最大ピッチP_3に属するブロックでの分断ピッチ比L_3/L_1が0.7〜1.3の範囲にあるように選択することが好ましい。なぜなら分断ピッチ比L_3/L_1が0.7未満又は1.3を越えると、最大ピッチP_3に属するブロックのせん断剛性差が大きくなり、第3図に示したように、騒音及び乗心地フィーリングが悪化する。なお、第3図には、サイズ185/70R14で第1図に示すトレッドパターンに準じたパターンを有するタイヤをFF車に装着し、一般路を走行した時の

フィーリング試験の結果を示す。

そして、ブロックに設ける切込みの本数を決定する基準となるピッチ長さは、騒音を抑制するために最小ピッチP_1及び最大ピッチP_3の比P_3/P_1が1.3以上であることが好ましく、1.3未満であるとピッチバリエーションを導入する意味がない。

(実施例)

第1図に示したトレッドパターンに準じて、タイヤサイズ185/70R14の空気入りラジアルタイヤを試作した。

ピッチバリエーションはピッチP_1: 27.04mm、ピッチP_2: 30.91mm及びピッチP_3: 39.10mm、すなわちピッチ比$P_1:P_2:P_3$は 8.7:10:12.6で、またピッチP_1及びP_2に属するブロックに切込み9を1本、またピッチP_3に属するブロックに切込み9を2本それぞれ設け、分断ピッチをL_1: 13.52mm、L_2: 15.46mm及びL_3: 13.03mmとした。なおタイヤの周溝1a, 1bの幅は 8.9mm、中央周溝2の幅は 8.2mm及び深さは全て 8.0mm、そして横溝の幅は3a, 3b: 2.8〜4.5mm、4a, 4b: 2.0〜3.1mm及び深さは 1.2〜7.0mmとした。

また比較として、第4図に示すトレッドパターンに準じた、すなわちピッチP_3に属するブロックに設ける切込み9を1本とした他は、上記のタイヤと同様の構成のタイヤについても試作した。

上記の各タイヤを5J×14のリムに組付け、2.2 kg/cm^{2}の内圧を適用すると共にFF車に装着して騒音及び車内こもり音そして耐偏摩耗性について評価試験を行った。騒音及び車内こもり音については、ザラメ路を60km/hで有効し、当該車両の前席中央ヘッドレスト高さに設置したマイクロホンを用いて測定評価し、一方、耐偏摩耗性は、当該車両にて2万km(一般路40%、高速路50%、そして山坂路10%)走行後の摩耗高さを測定評価したところ下表の結果を得た。

なお評価は、比較タイヤの測定結果を100としたときの指数で表し、指数が大きいほど良好な結果を示す。

	比較タイヤ	供試タイヤ
騒音評価	100	121
車内こもり音評価	100	135
耐偏摩耗性	100	137

(発明の効果)

この発明によれば、ピッチバリエーションを導入したブロックパターンのトレッドにおけるトレッド周上のブロック剛性を均一化することができ、騒音特性に優れかつ耐偏摩耗性の高い空気入りタイヤを提供し得る。

4. 図面の簡単な説明

第1図はこの発明に従う空気入りタイヤのトレッド要部の展開図、

第2図(a)〜(c)はブロックの分断を説明する模式図、

第3図は、第1図に示すトレッドパターンに準ずるパターンを有するタイヤの騒音及び乗心地フィーリング試験の結果を示す図、

第4図はこの発明と比較した空気入りタイヤのトレッド要部の展開図である。

1a, 1b …周溝　　2…中央周溝
3a, 3b、4a, 4b …横溝
5〜8…縦列ブロック群
5a〜5c、6a〜6c…ブロック
9…切込み　　10a, 10b, 12…補助横溝
11…補助切込み

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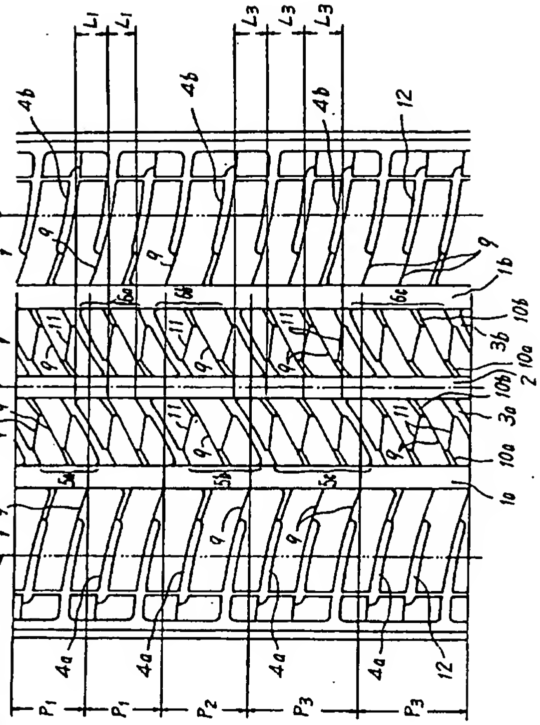
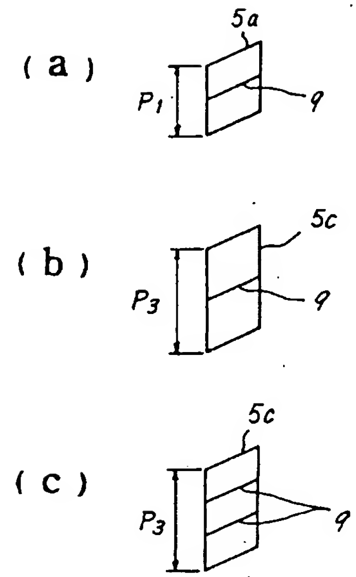
同　弁理士　冨田典
同　弁理士　梅本政夫
同　弁理士　仁平孝

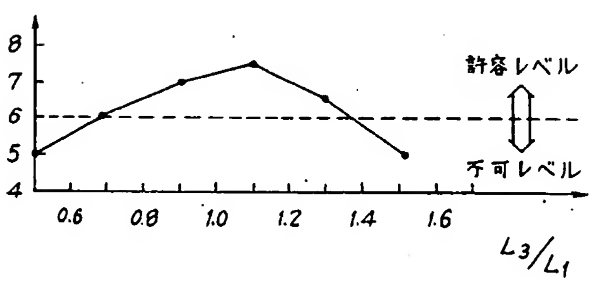
第1図



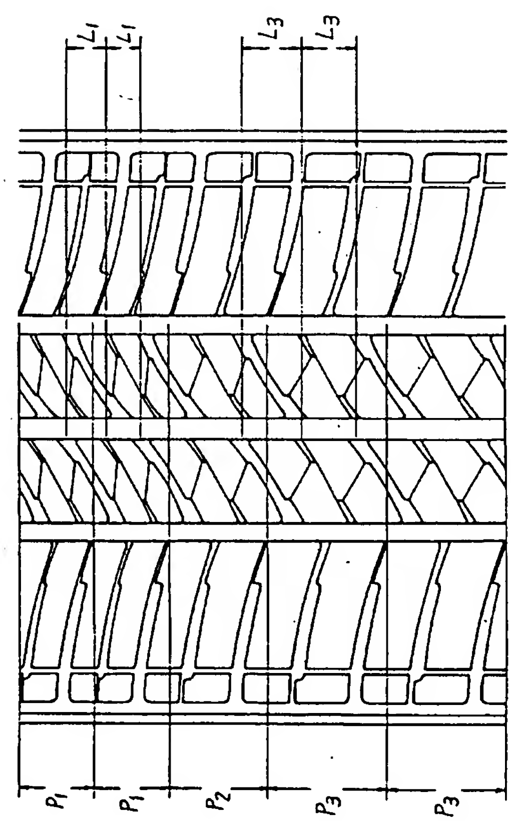
第2図



第3図



第4図



JAPANESE PATENT APPLICATION LAID-OPEN (KOKAI) NO. 4-201610

(Published: July 22, 1992)

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SPECIFICATION

1. TITLE OF THE INVENTION

NOISE-REDUCED PNEUMATIC TIRE

2. CLAIM

(1) A noise-reduced pneumatic tire having, on a tread extending into a toroidal shape over a pair of side walls, a plurality of groups of circumferentially-arranged blocks partitioned by a plurality of circumferential grooves extending along a circumference of the tread and a large number of lateral grooves extending in a direction intersecting these circumferential grooves, in which a pitch length is defined by a circumferential dimension of one block which includes one of a pair of lateral grooves forming opposite sides of the block, and each group of circumferentially-arranged blocks is constructed by a combination of various pitch lengths,

wherein said block has at least one slit which substantially divides said block in a circumferential

direction of the tire, and the number of slits provided in a block having a long pitch length is set to be greater than that in a block having a short pitch length.

3. DETAILED DESCRIPTION OF THE INVENTION

(INDUSTRIAL FIELD OF THE INVENTION)

The present invention relates to a pneumatic tire having a tread pattern in which tire noise, particularly, pattern noise, is reduced.

Tire noise is generated by various causes, and particularly, so-called pattern noise caused by a tread pattern is dominant among the kinds of tire noise. This pattern noise is generated by intermittent occurrence of a phenomenon in which air which is compressed between a ground contacting surface of a tread and a road surface rapidly flows to an outer side of the ground contacting surface of the tread via a groove of the tread. Pattern noise is also called pumping noise.

(PRIOR ART)

This pattern noise can be reduced by providing a so-called pitch variation to the tread pattern.

In other words, a structural dimension of a block, which is a circumferential dimension of one block divided by a circumferential groove of a tire tread and a lateral

groove intersecting the circumferential groove, including the dimension of one of a pair of lateral grooves which form opposite sides of the block, is set as a pitch. Various kinds of pitches having mutually different circumferential dimensions (in a case of an ordinary vehicle, three to five kinds of pitches) are arranged at random or regularly. This results in the reduction of the pattern noise.

(PROBLEMS TO BE SOLVED BY THE INVENTION)

In the block pattern to which this pitch variation is applied, since respective blocks arranged in a row in a circumferential direction of the tire have substantially similar configurations, the shearing rigidity of the blocks in the circumferential direction of the tire becomes nonuniform. Consequently, a circumferential, tangential force within a ground contacting surface of the tread varies during rotation of the tire. This variation of force produces an effect similar to that which is produced when a tread portion vibrates in the circumferential direction of the tire, and increases vibrations and noises generated on the ground contacting surface of the tread. As a result, reduction of noises by the pitch variation is prevented.

Further, when a difference is generated in rigidities of respective blocks, the ground contacting performance during the rotation of the tire deteriorates, and

maneuverability also deteriorates. In addition, the difference in rigidities of the blocks on the circumference of the tread may result in uneven wear.

Accordingly, in view of the above-described circumstances, it is an object of the present invention to provide a tread structure which is capable of substantially uniformizing the shearing rigidity of the blocks which have block patterns to which a pitch variation reducing the pattern noise is applied.

(MEANS FOR SOLVING THE PROBLEMS)

The present invention provides a noise-reduced pneumatic tire having, on a tread extending into a toroidal shape over a pair of side walls, a plurality of groups of circumferentially-arranged blocks partitioned by a plurality of circumferential grooves extending along a circumference of the tread and a large number of lateral grooves extending in a direction intersecting these circumferential grooves, in which a pitch length is defined by a circumferential dimension of one block which includes one of a pair of lateral grooves forming opposite sides of the block, and each group of circumferentially-arranged blocks is constructed by a combination of various pitch lengths,

wherein said block has at least one slit which substantially divides said block in a circumferential

direction of the tire, and the number of slits provided in a block having a long pitch length is set to be greater than that in a block having a short pitch length.

Fig. 1 shows a main part of a tread of a pneumatic tire according to the present invention. The tread is formed by dividing a surface of the tire by circumferential grooves 1a, 1b, a circumferential center groove 2, and lateral grooves 3a, 3b and 4a, 4b into four groups of blocks 5, 6, 7 and 8. The circumferential grooves 1a, 1b extend along a circumferential center line O and constitute a pair of grooves at respective sides of the circumferential center line O. The circumferential center groove 2 extends along and is disposed on the circumferential center line O. The lateral grooves 3a, 3b, and 4a, 4b extend in a direction intersecting these circumferential grooves and connect the circumferential grooves to each other and connect each of the circumferential grooves 1a, 1b to tread ends T. Each group of the blocks 5, 6, 7 and 8 is disposed along the circumferential direction of the tire, and two rows of groups are arranged on either side of the circumferential center line O, so that four rows of groups are disposed as a whole.

These groups of circumferentially-arranged blocks, 5, 6, 7 and 8 are each arranged in a state in which a plurality of pitches is combined with each other in accordance with a

predetermined pitch variation. Namely, a circumferential dimension of each block, including the dimension of one adjacent lateral groove, varies in accordance with each pitch length of various kinds of pitch.

The two groups of blocks, 5 and 6, which are disposed symmetrically about the circumferential center line 0 of the tread, will be described. The pitch variation to be applied is formed by three kinds of pitch, P1, P2 and P3 (P1 < P2 < P3) which have mutually different circumferential dimensions. Each group of blocks is formed by blocks having three kinds of circumferential lengths corresponding to the above-described three kinds of pitches. In other words, in these groups of blocks, 5 and 6, blocks 5a and 6a each correspond to pitch P1, and similarly, blocks 5b and 6b each correspond to pitch P2, and blocks 5c and 6c each correspond to pitch P3.

Further, each block is provided with a slit 9 which divides the block into two substantially equal parts in the circumferential direction of the tire. In this embodiment, the slit 9 extends parallel to the lateral grooves 3a, 3b. The number of slits 9 provided in the block having a long pitch length is greater than that in the block having a short pitch length.

Namely, in the example illustrated in Fig. 1, one slit 9 is provided in each of the blocks 5a, 5b, 6a and 6b which

correspond to the pitch P1 and the pitch P2, while two slits 9 are provided in each of the blocks 5c and 6c which correspond to the pitch P3. Thus, at the least, there occurs a difference in the number of slits between the block corresponding to the smallest pitch length P1 and the block corresponding to the longest pitch length P3.

Here, the circumferential length of a portion, which is divided by the slit 9, of each block is represented as a divided pitch. Assuming that the divided pitch of the blocks 5a, 6a corresponding to the pitch P1 is indicated by L1, and the divided pitch of the blocks 5c, 6c corresponding to the pitch P3 is indicated by L3, the divided pitches L1 and L3 will approximate to each other in accordance with the difference in the number of slits 9.

The slit 9 opens to the circumferential grooves 1a, 1b and the circumferential center groove 2 via auxiliary lateral grooves 10a, 10b. In addition, an auxiliary slit 11 connects the auxiliary lateral groove 10a and the auxiliary lateral groove 10b, and connects these auxiliary lateral grooves and the lateral grooves 3a, 3b, respectively, via a course different than that of the slit 9.

Further, in the example illustrated in Fig. 1, also in the groups of circumferentially-arranged blocks 7 and 8, which are disposed on outer sides of the above-described groups of blocks 5 and 6, the pitch variation is applied to

the block patterns of these groups of blocks 7 and 8, and the number of slits 9 of each block is varied so as to correspond to the pitch length of the block. It suffices to vary the number of slits 9 only in the groups of blocks 5 and 6.

Further, in the groups of blocks 7 and 8, lateral grooves 4a, 4b are formed such that a portion thereof disposed at the side of the circumferential grooves 1a, 1b is made shallow and a portion thereof disposed at the side of the tread end T is made deep. Further, the slit 9 extending from the side of each of the circumferential grooves 1a, 1b, is connected to an auxiliary lateral groove 12 extending toward the side of a shoulder portion of the tire.

It should be noted that other structures of the tire according to the present invention may conform to any standards of conventional tires.

Namely, a carcass is formed by at least one sheet (at most three sheets) of turned-up ply which is turned around a bead core from an inner side to an outer side of the tire. The ply is formed such that fiber cords such as rayon, nylon, and polyester, are arranged in a direction substantially perpendicular to an equatorial plane of the tire (i.e., a radial direction). A belt layer is formed of at least two main belt layers and at least one auxiliary

belt layer. The main belt layers are each constructed such that inextensible cords such as steel cords, aromatic polyamide fiber cords, or the like, are arranged at an angle of 10 to 35° with respect to the equatorial plane of the tire, and at least two main belt layers are disposed so as to intersect each other. In the auxiliary belt layer, heat-contractive cords such as nylon cords, are disposed substantially parallel to the equatorial plane of the tire over the full width of the main belt layer. In order to form the auxiliary belt layer, a plurality of cords which is arranged in a ribbon configuration along the circumference of the main belt layer and is helically wound, is used. Then, the above-described tread is placed on this belt layer.

(OPERATION)

In a block pattern to which a pitch variation is applied, the provision of a difference in the number of slits for each block such that the number thereof corresponds to the pitch length makes it possible to uniformize the divided pitches in each block, and to uniformize the shearing rigidity of the blocks and a circumferential, tangential force of the block.

Namely, it is considered that the tangential force of the block is proportional to the circumferential shearing

rigidity of the block, and that this shearing rigidity is proportional to the circumferential length of the block taken to about the third power.

For example, as illustrated in Fig. 2(a) and Fig. 2(b), in a case in which the blocks 5a and 5c have the smallest pitch length P1 and the largest pitch length P3 respectively, and are respectively divided, by one slit 9, equally into two parts in the circumferential direction of the tire, the ratio of shearing rigidity between the block 5a and the block 5c is expressed as follows:

$$\{2 \times (P_3/2)^3\} / \{2 \times (P_1/2)^3\} = (P3/P1)^3$$

wherein the respective circumferential lengths of the blocks 5a, 5c are indicated by P1 and P3. Thus, since the shearing rigidity is proportional to the pitch length, the shearing rigidity of the block 5c becomes higher than that of the block 5a.

On the contrary, as illustrated in Fig. 2(c), in a case in which the block 5c having the maximum pitch length P3 is equally divided by two slits 9 in the circumferential direction, the ratio of the shearing rigidity between the block 5a and the block 5c is expressed as follows:

$$\{3 \times (P_3/2)^3\} / \{2 \times (P_1/2)^3\} = 2/3(P3/P1)^3$$

The ratio of shearing rigidity in this example shown in Fig. 2(c) decreases to 2/3 in comparison with the example shown in Fig. 2(b), so that the shearing rigidities of the blocks

5a and 5b tend toward uniformization.

Here, the number of slits provided in the block is preferably selected such that the ratio of the divided pitches, L3/L1, between the block having the minimum pitch P1 and the block having the maximum pitch P3, is set in the range of 0.7 to 1.3. The reason is that, if the ratio of the divided pitches, L3/L1, is less than 0.7 or greater than 1.3, the difference in the respective shearing rigidities of the block having the maximum pitch P3 and the block having the minimum pitch P1 becomes large, thereby exacerbating the tire noise and deteriorating the comfort of the ride, as shown in Fig. 3. Fig. 3 shows the results of a feeling test using tires of size 185/70R14 which have patterns corresponding to the tread pattern shown in Fig. 1. The tires were mounted on FF-type vehicles and the vehicles were driven on paved roads.

The pitch length, which is a standard for determining the number of slits provided in the block, is preferably set such that the ratio P3/P1 of the minimum pitch P1 and the maximum pitch P3 is greater than or equal to 1.3, in order to control noise. If the ratio P3/P1 is less than 1.3, the introduction of pitch variation is no longer required.

(EMBODIMENTS)

A pneumatic tire of size 185/70R14 was prepared in

accordance with the tread pattern shown in Fig. 1.

The pitch variation was constructed such that pitch P1 was 27.04 mm, pitch P2 was 30.91 mm, and pitch P3 was 39.10 mm, so that the pitch ratio, P1 : P2 : P3, was 8.7:10:12.6. One slit 9 was provided in the blocks having pitches P1 and P2, respectively, and two slits 9 were provided in each block having pitch P3. Thus, the divided pitches, L1, L2 and L3 were respectively 13.52 mm, 15.46 mm, and 13.03 mm. The width of the circumferential grooves 1a, 1b was 8.9 mm, the width of the circumferential center groove 2 was 8.2 mm, and the depths of all of the circumferential grooves were 8.0 mm. Further, the widths of the lateral grooves 3a, 3b were 2.8 to 4.5 mm, the widths of the lateral grooves 4a, 4b were 2.0 to 3.1 mm, and the depths of these lateral grooves were 1.2 to 7.0 mm.

Further, a tire according to a tread pattern shown in Fig. 4, having the same structure as that of the above-described tire except that one slit 9 was provided in the block having the pitch length P3, was produced as a comparison tire.

The above-described tires were attached to 5J x 14 rims and were inflated to internal pressures of 2.2 kg/cm^2. The tires were placed on FF-type vehicles, and an evaluation test on tire noise, interior booming noise, and irregular wear resistance was performed. In the evaluation test on

tire noise and interior booming noise, the vehicles were driven at speeds of 60 km/h on rough roads, and a microphone placed in the center of the front seat of each of the vehicles at a position at the height of the head rest, was used for measurement in this test. Further, in the evaluation test on irregular wear resistance, the wear height after a 20,000 km running test (40% of this travel distance was on paved roads, 50% was on expressway roads, and 10% was on mountain or sloped roads) was measured.

The results of this test are given in the following table. The measured results of the comparison tire is given as an index number of 100. Larger numbers are more preferable.

	Comparison Tire	Present Example
Evaluation of Noise	100	121
Evaluation of Interior Booming Noise	100	135
Irregular Wear Resistance	100	137

5, 6, 7, 8 ..... group of circumferentially-arranged blocks

5a, 5b, 5c, 6a, 6b, 6c ..... block

9 ..... slit

10a, 10b, 12 ..... auxiliary lateral groove

11 ..... auxiliary slit